No. 98 May 2001

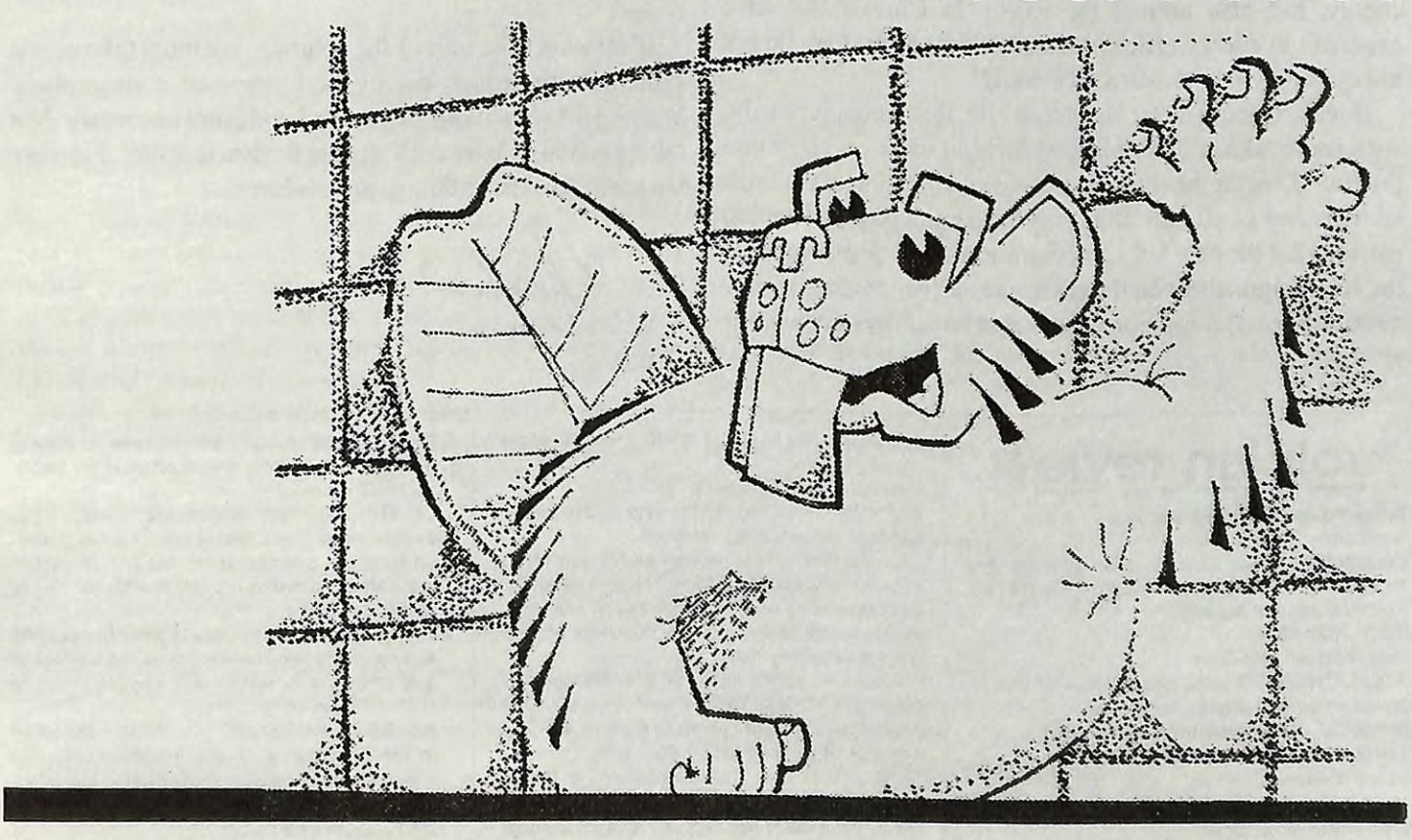
solplan review

the independent journal of energy conservation, building science & construction practice

Contents . . .

Mould and Indoor Health ---------- 3
New York City Remediation Guidelines ---------- 4
Cleaning Up Mould ---------- 5
Duct Sealing ---------- 6
Letters to the Editor ---------- 7
Building Homes That Are Solar Ready ---------- 8
Waterproof Door Sills ---------- 9
Advanced Technology, Healthy and Energy Efficient New Homes ---------- 10
Technical Research Committee News ---------- 11
Envirohome 2000; Moisture and Wood-Frame Buildings; Fire Safety in Residential Buildings
Water Problems at the Source ---------- 12
Canada and the USA: Differences in the Energy Efficient Housing Scene ---------- 13
Durability of Wall Systems Containing Housewrap ---------- 14
Energy Answers ---------- 16
New Guidelines for a Sustainable Municipal Infrastructure ---------- 17
Traffic Vibrations in Houses ---------- 18

Mould and Indoor Health



From the Editor . . .

There has been much talk about globalization and free trade recently. Proponents profess that unfettered free trade will cure all that ails the world. Opponents are characterized as incoherent rabble, presumably adherents of some discredited ideology, who want to stop progress at all costs. Although it may not seem so, the free trade debate touches on the housing industry to a greater degree than we may think.

Increasingly housing exports, whether simply building materials and components, whole house packages, or housing technology systems are becoming a part of world commerce. International trade is already a part of our industry, and Canada is taking an active role in it. Thus, it is necessary to take note of the ebb and flow of international as well as local commerce. With increased international activity, it is doubly important to be aware of not just trade and legislative regulations, but also climatic and cultural factors. The climate sensitivity of construction assemblies is vital for successful and durable building performance.

What must also be taken into consideration is the energy performance of buildings. Buildings are major consumers of energy, not only in Canada, where they use one third of all energy, but also around the world. In Canada, we have expertise in energy efficient construction, even if we do not always apply it as much as we could.

If we are going to tackle global climate change seriously, we have to take action right now and put what we know into practice. Despite the rhetoric and wishful thinking of the Bush administration, climate change is happening now and getting worse. That the new US administration has foolishly rejected the Kyoto agreement on the environment (which itself is only a starting point) is a major setback, but hopefully only a short-term one.

The US administration is ignoring the facts and denying that the earth's ecosystem knows no boundaries. Environmental impacts in one country also affect other countries. We need only remind ourselves that the explosion in the Chernobyl nuclear plant scattered radiation not only in its vicinity but also throughout neighbouring Scandinavian countries. In the past few weeks, there was a haze in the skies in western North America, from Whitehorse to Denver, as a result of dust storms in the Gobi desert of Northern China. The air streams in the upper atmosphere carried the dust across the Pacific Ocean, half way around the world.

The largest consumers of energy are also the largest polluters and contributors to greenhouse gas emissions. We in North America are the largest per capita energy users, and have the means and knowledge to reduce this energy consumption, if only we apply ourselves to doing it. Unfortunately, there is a decided lack of commitment to take action. Current US policy direction is trying to sweep the issue further under the carpet. Some days it seems that no matter how much we know about a subject, or how serious the issue, corporate inertia or mass denial keeps us from doing the right thing.

If we want to be part of the solution, we must take action right now to reduce energy and resource consumption. Waiting for regulations to be mandated is not necessary. Not taking action will worsen the crunch when it comes. How are we going to explain that to our children?

Richard Kadulski,
Editor

solplan review
the independent journal of energy conservation, building science & construction practice

Editor-Publisher: Richard Kadulski
Illustrations: Terry Lyster
Contributors: Steve Crowell, John Broniek, Eric Burnett, Osama Hunaidi, Jim Gallagher, Rob Dumont, Rod Parsons, Jim Stewart
ISSN: 0828-6574
Date of Issue: June 2001
SOLPLAN REVIEW is published 6 times per year by: the drawing-room graphic services ltd.
Box 86627, North Vancouver, BC V7L 4L2
Tel: 604-689-1841 Fax: 604-689-1841
e-mail: solplan@direct.ca
Street address:
#204 - 1037 West Broadway
Vancouver, BC V6H 1E3

Canadian Publications Mail Product Sales Agreement No. 454532
Postage paid in Vancouver, BC.
COPYRIGHT 2001 by The Drawing-Room Graphic Services Ltd. All rights reserved.
Reproduction without written permission of the publisher is strictly forbidden. Transgressors who don't take heed note: those spots you see in the basement will be the precursor of a visitor who will leave a surprising mark.
A license for photocopying or other reprographic copying can be also be obtained from CANCOPY (Canadian Copyright Licensing Agency, #900 - 6 Adelaide St E, Toronto ON M5C 1H6).
SUBSCRIPTIONS: In Canada 1 year $48.15 (incl GST) (NB, NS, NF $51.75 includes HST); 2 years $86.67 (incl GST) (NB, NS, NF $93.15 includes HST). USA and other foreign payable in US $ 1 year $52.00, 2 years $94.00.

CHANGE OF ADDRESS: include a mailing label or copy all information off label for faster, accurate processing.
CONTRIBUTIONS: Unsolicited contributions and manuscripts welcome. Include self-addressed pre-stamped mailer if return requested. Publisher not responsible for loss or damage of same.
While every effort is made to provide accurate and complete information, we do not warrant or guarantee the accuracy and completeness of such information.
ADVERTISING POLICY: Publisher's discretion in the acceptance of any advertisement. No endorsement is stated or implied by the publisher.
PRINTED IN CANADA
GST Registration: R105208805
SOLPLAN is a registered trademark of the Drawing-Room Graphic Services Ltd.

Mould and Indoor Health

Improving Health By Controlling Moulds

Moulds (also known as fungi) are present everywhere in indoor and outdoor environments. One quarter of all biomass on earth is fungal matter. Fungi are important elements that degrade and recycle natural materials. There is at least one fungus species to break down each type of organic material on earth. Without fungi, life on earth as we know it would not be possible.

A cynic would say that since no vested economic interests are creating or supporting moulds, a big effort is going to put into dealing with them, much as has happened with radon remediation. However, moulds are a health concern. High levels of moulds in a building environment are to be avoided. Some species or high concentrations of mould are a serious health risk, and must be dealt with if we want to maintain healthy indoor environments.

Fungi in buildings may cause or exacerbate allergic symptoms. The commonest symptoms of fungal exposure are fatigue, respiratory ailments, runny nose, eye irritation, cough, congestion, wheezing, chest tightness, shortness of breath, and aggravation of asthma. People with a history of allergic diseases (e.g., asthma and rhinitis) as especially vulnerable.

In order for people to be exposed indoors, fungal spores, fragments, or metabolites (e.g., mycotoxins and volatile organic compounds) must be released into the air and inhaled, be physically contacted or ingested. Whether or not symptoms develop depends on the nature of the material (e.g., allergenic, toxic, or infectious), the degree of exposure, and the vulnerability of the person exposed to the mould. Susceptibility varies with an individual's genetic predisposition (allergic reactions do not always occur in all individuals), age, state of health, and concurrent exposures.

Because there has been no standardized measurement, biological markers of exposure to mould are largely unknown. It is not possible to determine general "safe" or "unsafe" exposure levels. Infants, persons recovering from recent surgery, or individuals with compromised immune systems, asthma, hypersensitivity pneumonitis, severe allergies, sinusitis, or other chronic inflammatory lung diseases may be at greater risk for developing health problems associated with some moulds. Such people should be removed from an affected area during remediation work.

Building materials supporting fungal growth must be remediated as quickly as possible to ensure a healthy environment. Building components (walls, ventilation systems, basements, etc.) that are chronically moist or water damaged are most likely to be contaminated. The presence of mould, water damage, or musty odours should be addressed immediately. The underlying cause of water accumulation must always be corrected or mould growth will recur.

Prompt clean-up and repair of contaminated material is the primary response to mould contamination in buildings. Emphasis should always be placed on preventing contamination through proper building and mechanical system maintenance and prompt repair of water damage. Indoor relative humidity should be kept at levels below 60% to inhibit mould growth.

Specific methods of assessing and remediating fungal contamination should be based on the extent of visible contamination and the underlying damage. The simplest and most expedient remediation that properly and safely removes fungal contamination should be used. Except in cases of widespread fungal contamination, building-wide evacuation is not necessary.

A visual inspection is the most important first step in identifying a possible contamination problem. The extent of any water damage and mould growth should be visually assessed. This assessment is important in determining remedial strategies. The use of respiratory protection (e.g., a N95 disposable respirator), gloves, and eye protection are recommended. Extensive contamination should be assessed by an experienced health and safety professional and remediated by personnel with

training and experience handling environmentally contaminated materials.

During a visual inspection, careful attention should be given to ceiling tiles, gypsum board, cardboard, paper, and other cellulosic surfaces. Sampling is not required to undertake a remediation, which should be done as quickly as possible.

Samples may only have to be collected to identify specific contaminants for a medical evaluation or to identify the presence or absence of mould when a visual inspection is uncertain. An individual trained in appropriate sampling methodology should do the sampling.

Air Monitoring

Air sampling for moulds is not necessary for a routine evaluation because decisions about appropriate remediation strategies can usually be made based on a visual inspection. As well, air-sampling methods for some moulds can give false negative results and cannot be used to rule out contamination definitively.

New York City Remediation Guidelines

Currently there are no regulations for evaluating potential health effects of fungal contamination and remediation. Guidelines developed by the City of New York are considered as the standard. We have summarized the guidelines here.

The goal of remediation is to remove or clean contaminated materials in a way that prevents the spread of spores and dust contaminated with mould from leaving the work area while protecting the health of workers doing the work.

The New York City Guidelines use five levels of abatement based on the size of the area affected by fungal contamination.

In all cases, non-porous (e.g., metals, glass, and hard plastics) and semi-porous (e.g., wood, and concrete) materials that are structurally sound and visibly mouldy can be cleaned using a detergent solution. Porous materials such as ceiling tiles, insulation, fibreboard, fabrics and wallboards with more than a small area of contamination should be removed and discarded. Porous materials that can be cleaned, can be reused, but if possible should be discarded. All materials to be reused should be dry and visibly free of mould.

Dust suppression, such as misting (not soaking) surfaces before remediation is recommended. Contaminated materials that cannot be cleaned should be removed in a sealed plastic bag. There are no special requirements for the disposal of mouldy materials.

The use of ozone or bleach for remedial purposes is not recommended. Both compounds are highly toxic and contamination of occupied space may pose a health threat.

To control mould growth:

1. Repair indoor and outdoor water leaks
2. Clean and disinfect smooth surfaces
3. Clean and dry other materials or remove them
4. Discard porous contaminated materials
5. Control moisture sources (e.g., indoor relative humidity, standing water around mechanical equipment).

Level 1: Small Isolated Areas (10 sq. ft or less)

Respiratory protection is recommended. Gloves and eye protection should be worn. The work area should be unoccupied, but adjoining areas need not be evacuated. Containment of the work area is not necessary.

The work area and areas used by remedial workers for access should be cleaned with a damp cloth and/or mop and a detergent solution. All areas should be left dry and visibly free from contamination and debris.

Level 2: Mid-Sized Isolated Areas (10 - 30 sq. ft.)

Respiratory protection is recommended. Gloves and eye protection should be worn. The work area should be unoccupied and covered with a plastic sheet(s) and sealed with tape to contain dust/debris.

The work area and areas used by remedial workers for access should be HEPA vacuumed (a vacuum equipped with a High-Efficiency Particulate Air filter) and cleaned with a damp cloth and/or mop and a detergent solution. All areas should be left dry and visibly free from contamination and debris.

Level 3: Large Isolated Areas (30 - 100 square feet)

A health and safety professional with experience doing microbial investigations should be consulted before doing remediation to provide oversight for the project. Only personnel trained in the handling of hazardous materials and equipped with respiratory protection should do the work. Respiratory protection, gloves and eye protection should be worn.

The work area and areas directly adjacent should be covered with a plastic sheet(s) and taped to contain dust and debris. Ventilation ducts and grilles in the work area and areas directly adjacent should be sealed with plastic sheeting. The work area and adjacent areas should be unoccupied.

The work area and surrounding areas should be HEPA vacuumed and cleaned with a damp cloth and/or mop and a detergent solution. All areas should be left dry and visibly free from contamination and debris.

Level 4: Extensive Contamination (more than 100 square feet in an area)

A health and safety professional with experience performing microbial investigations should be consulted before doing remediation activities to provide oversight for the project. Personnel trained in the handling of hazardous materials should be equipped with full-face respirators with high efficiency particulate air (HEPA) cartridges, disposable protective clothing covering both head and shoes, and gloves.

The work area should be completely isolated from occupied spaces using plastic sheeting sealed with duct tape (including ventilation ducts and grilles, fixtures, and any other openings). An exhaust fan with a HEPA filter to generate negative pressurization compared with the rest of the building should be used. There should be an Airlock and decontamination room between the work area and the rest of the building.

Vacating people from spaces next to the work area is not necessary. However, it is recommended that infants, persons having undergone recent surgery, immune-suppressed people, or people with chronic inflammatory lung diseases (e.g., asthma, hypersensitivity pneumonitis, and severe allergies) should leave.

Contaminated materials that cannot be cleaned should be removed from the building in sealed plastic bags. The outside of the bags should be cleaned with a damp cloth and a detergent solution or HEPA vacuumed before being taken to uncontaminated areas of the building. There are no special requirements for the disposal of mouldy materials.

The contained area and decontamination room should be HEPA vacuumed and cleaned with a damp cloth and/or mop with a detergent solution and be visibly clean before the removal of isolation barriers.

Air monitoring should be conducted before occupancy to determine if the area is fit to reoccupy.

Level 5: Remediation of Heating and Ventilating Systems

The mechanical system should be shut down before any remedial work is done. Emphasis should be placed on preventing contamination through proper building maintenance and prompt repair of water damaged areas.

Widespread contamination is a much larger problem that must be dealt with on a case-by-case basis in consultation with a health and safety specialist. This is a particularly potential problem in larger commercial buildings. However, smaller residential buildings and houses could have problems, especially if air conditioning and humidification is part of the mechanical system.

Contaminated, growth-supporting materials, such as the paper on the insulation of interior lined ducts and filters, should be removed. Other contaminated materials that cannot be cleaned should be removed in sealed plastic bags.

The work area and areas immediately surrounding it should be HEPA vacuumed and cleaned with a damp cloth and/or mop and a detergent solution. Biocides are often recommended. However, they should be used with caution, as they may compromise the general indoor air quality, and create other problems. Specific products to be used should be carefully evaluated, and verified that they are acceptable for use with the system.

Cleaning Up Mould

There are two ways to clean up moulds. The objective of both ways is to prevent fine particles from being thrown back into the room.

The first is to vacuum mouldy materials or surfaces with a HEPA vacuum or a central vacuum exhausted directly to the exterior (and not into the garage). Vacuuming removes loose organic material, which will make the cleaning safer and easier. Dust is stirred up, so *respiratory protection is important, and the space should be unoccupied.* Vacuuming should precede cleaning with other cleaning substances. Vacuuming is also the way to clean most surfaces that cannot be washed; for example, upholstered furniture.

Upholstered furnishings that have been exposed to damp conditions over a prolonged period cannot be cleaned; they should be re-upholstered or preferably discarded.

The second is to use a solution of detergent (e.g., unscented dishwashing liquid) and water, and rinse well. Bleach is no longer recommended for a general mould cleanup as it was in the past (older publications will recommend it). Bleach is now used only to clean mould off badly contaminated wood surfaces. When using bleach, ventilation of the area and respiratory protection are essential. Concrete surfaces can be cleaned with tri-sodium phosphate (TSP) and water. Prepare by adding one cup of TSP to 2 gallons of warm water. Eye and skin protection is necessary.

When washing, the affected areas should not be saturated, and the space should be well ventilated to speed drying of the cleaned surfaces.

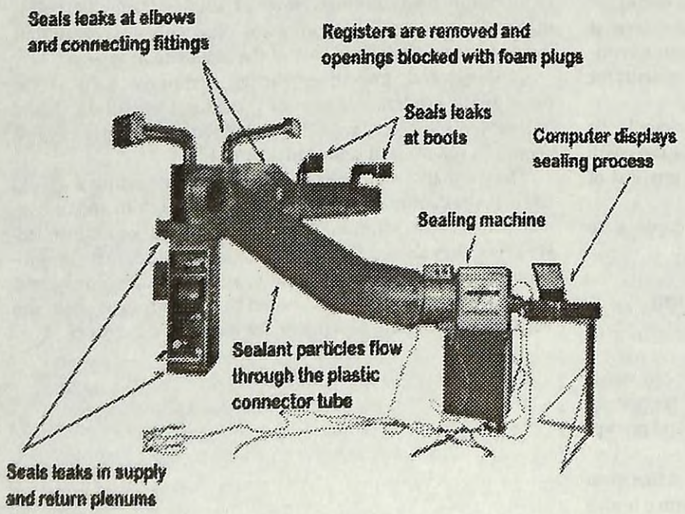
Duct Sealing

Air leakage in ducts is a source of many problems related to indoor environment. Ducts through unheated spaces lose conditioned air and contribute to significant energy loss. Leaky ducts, whether inside or outside, also distribute dust because the duct work can contribute to pressure imbalances between different parts of the house. The tell-tale staining of light-coloured carpets at outside walls or near heating grilles is an indication of such dust movement.

Leaky ducts also mean that conditioned air (whether heated, cooled, or ventilation air) will not be delivered where it is intended to go. By sealing ducts, the overall efficiency of heating and cooling systems can be increased by as much as 20 percent. The U.S. Department of Energy estimates that energy loss from leaky residential ducts alone is equivalent to the energy burned by 13 million cars a year.

It is such a big problem, that the U.S. Energy Star program has an Energy Star Duct Specification designed for retrofit of existing homes. The increased efficiency lowers energy bills and increases comfort and safety, while benefiting the environment by reducing emissions from sources powering the heating and cooling process.

For information:
Aeroseal Inc.
Tel.: 512-445-2504
Fax 512-445-3316
www.aeroseal.com


Seals leaks at elbows and connecting fittings
Registers are removed and openings blocked with foam plugs
Seals leaks at boots
Computer displays sealing process
Sealing machine
Sealant particles flow through the plastic connector tube
Seals leaks in supply and return plenums

Much of the problem is the result of poor duct system design and installation. We know about it, yet most duct systems are rarely checked for duct leakage, proper room air flow, temperature, or return air flows.

Air tight ducts improve indoor air quality and increase indoor comfort, as improved air flow makes even marginal rooms liveable. Tight duct systems, especially return air ducts, reduce dust, attic and basement smells and reduce the possibility of radon and other soil gasses from being pulled into the home. When new systems are installed, they are relatively easy to air seal. However, that is not the case with existing installations.

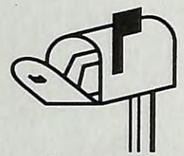
A recently developed technology from California provides a way to duct seal installed residential systems in two to three hours. The ***Aeroseal*** technology uses a fan to blow a small quantity of dry adhesive particles through the temporarily sealed duct system. With registers and the furnace blocked, the suspended sticky particles travel in the airflow toward the only place left for the air to exit - the cracks and leaks. As the air stream turns sharply through leaks, the particles are deposited directly on the edges of holes to create seals. The material can span leaks as large as 5/8 inch across - without leaving excess deposits on duct surfaces.

The particles are small enough (2 to 20 mm in diameter) to reach leaks before settling out of the air stream. Once the particles are deposited on the duct walls, there is no measurable loss in air flow.

The sealing material is guaranteed for 10 years and has been tested by Underwriters Laboratories Inc. (UL) and the Indoor Environment Program at Lawrence Berkeley Laboratory.

Aeroseal Inc. is franchising the technology to experienced HVAC companies currently in the business. They train and certify the contractors to use the computerized duct system diagnostics and the aerosol sealing technology. Customers receive a computer analysis of the condition of the ducts before work starts and when work is completed, and a certificate that their system has been properly sealed.

For consumers, the technology provides air duct services that save money, make rooms more comfortable, improve indoor air quality, and conserve energy.



Letters to the Editor

Re: Attached Garages and Indoor Air Quality (Solplan Review No 97, March 2001)

The Canadian Commission on Building and Fire Codes recently approved interim changes that deal with the separation of storage and repair garages from dwelling units. These changes do not have to wait until the next edition of the National Building Code in 2003 to become effective; because they are safety-related, they may be carried out immediately. Timing will vary from province to province, so readers should check w their local authorities.

The members of the Standing Committee on Houses are well aware of the health issue related to CO and other contaminant leakage into the house from the garage. The approved new sentences in NBC 9.10.16 *Separation of Storage Garages* and NBC 9.10.9.17 *Separation of Repair Garages* to require that an air barrier system conforming to Subsection 9.25.3 be installed between the garage and the remainder of the building to provide an effective barrier to gas and exhaust fumes. When membrane materials are used to provide the required air tightness, all joints must be sealed and structurally supported. As well, every door between a storage garage and the remainder of the building must conform to Article 9.10.13.15.

In addition, a special change dealing with contaminant transfer has been approved. New Article 9.33.4.7 *Contaminant Transfer* states that systems serving garages, and systems serving other occupied parts of the dwelling unit but located in or running through a garage, shall be designed and constructed in a manner such that means are not provided for the transfer of contaminants from the garage into other spaces in the dwelling unit.

Thank you for the opportunity to inform your readers of these important changes.

Madeline McBride, P.Eng
Technical Advisor, Standing Committee on Houses,
Canadian Codes Centre, IRC, NRC

I am pleased to see that the language is being strengthened. The challenge, of course, is that code requirements are not always implemented correctly, as we've seen with mechanical ventilation requirements. Good intentions don't always get carried out. Ed.

Re: Attached Garages and Indoor Air Quality and Editors' comments (Solplan Review No. 97, March 2001)

Thanks for opening a discussion on carbon monoxide (CO) and garages attached to dwellings. In 25 years of pre-purchase condition surveying ("home inspections") I have noticed many things:

- Many furnace rooms situated between the living area and garage (with access from the garage) have a moderate to high negative air pressure;
- A significant number have a poor seal between the cold air duct work and the furnace cabinet;
- A significant number have poor or worn out weather stripping on the furnace room door, no auto-closer or a poorly adjusted or disarmed auto-closer. Needless to say, as the furnace filters load up (and these are often plugged), the negative pressure within the space is likely to increase. Some of these furnaces are in continuous fan running mode.
- Garages in older homes with free standing furnaces, (i.e., no separate furnace room), and some with no outdoor air supply, most with a poor return air/furnace seal.
- Garages containing an entrance to a basement. Usually air sealing has been attempted but has not always been maintained.
- Garages with an entrance to the crawlspace. These are rarely air sealed.
- Garages with warm air supplied to the space (either originally or later). It usually takes a while to have the new owner understand the relationship between this fact and negative pressure within the dwelling and/or furnace room.
- Garages with soffit ventilation all-round and an easy path for exhaust (particularly from those cars pulled half way out of the garage to warm up) to migrate to living areas, make-up air ducts or return air ducts via adjacent or connected attic areas.
- Garages with just about every noxious chemical imaginable stored in them.

Also, thanks for an ongoing dialogue re: seismic resistance in Part 9 buildings. Yes, we will be in a sorry mess should a significant event occur, in part because there is not enough discussion around this issue within the industry. Perhaps we should

just start with some basics. It is not very uncommon for home inspectors to discover:

- Anchor bolts with loose nuts, no washers or no nuts at all (and these are only the houses with visible sole-plates).
- Sheet metal ties that are poorly nailed and/or extremely loose and/or poorly placed and/or few in number. Personally, I cannot see these ties holding a few pieces of lumber onto a delivery truck let alone keep a house on its foundation during a serious earthquake.
- Toe-nails holding critical elements together in large buildings; poor post and beam fasteners, etc.
- I could go on to talk about soft storeys (floors over large open areas, such as double garages), stairwell openings, and top-heavy, tile-roofed houses, etc.

We are still very sloppy in some really basic areas. We all have ideas about what is out there in dwellings new and old. Let us talk about it, and learn from past mistakes.

David Riley
White Rock, BC

Building Homes That Are Solar Ready

Solar energy can contribute about 50% of a typical home's annual domestic hot water needs. When building a new home, always consider pre-plumbing for a solar system. This can be done at little added cost, and used as a marketing tool that the house is "solar ready."

What is needed to make a house solar ready?

The following requirements are not specific to a single manufacturer, but would allow the installation of most typical solar domestic hot water systems.

One pair of insulated ½" diameter copper pipes should be installed, running from the mechanical room up to the roof. These pipes should end above the finished roof, and be flashed as required. It goes without saying that the roof should be south facing, and have an unobstructed area, free of vents, gables, antennas, etc.

The roof space required depends on the type and size of solar system, but typically an area of about 100 sq.ft. will be needed for a domestic solar hot water heating system.

The pipes should be sloped back to the heated space. This will allow drain-back systems to be used. Besides the piping, a pair of shielded 18-gauge wires should be installed from the roof to the mechanical room to allow for system controls.

The mechanical room should have enough floor space to allow installation of a storage tank. This would likely be a standard 30 - 50 US gallon tank.

Solplan Review Back issues

A limited number of back issues are available, at a special price of $5.50 each (plus 7% GST). Bundle special: a random selection of back issues (minimum 22 copies) are available for only $60.00 (plus 7% GST)

Solplan Review
Box 86627
North Vancouver, BC V7L 4L2
e-mail: solplan@direct.ca

Re: "Measuring Backdraft for Health and Safety." Solplan Review No. 96, January 2001

This is a small point but, in the research on combustion spillage done for CMHC in the 1980's (in which I was involved) and subsequent incorporation of the results of that research in codes and standards, we have tried to limit the use of the term "backdraft" to describe the situation where all of the flow in a chimney or vent is inward. This is a specific instance of the more general (and more common) case in which only some portion of that flow is inwards while the rest is outwards. The more general case is called "spillage" or "combustion products spillage" or "pressure-induced combustion products spillage."

Re: "Energy Answers" Solplan Review No. 96, January 2001

Rob Dumont has an excellent discussion of furnace over-sizing, but he fails to note two relevant facts:

1. The National Building Code (9.33.5.1) requires that the required heating capacity of heating appliances be determined in accordance with CSA Standard F280, "Determining the Required Capacity of Residential Space Heating and Cooling Appliances."

2. CSA F280 sets a 40% limit on over-sizing of the installed capacity of the appliance as compared to the calculated heat loss for the house at the January 2 ½% temperature.

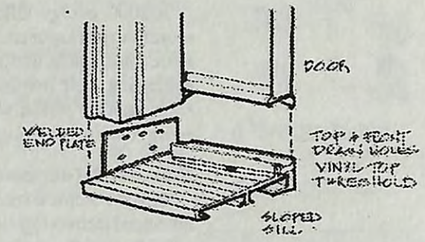
John C. Haysom, P. Eng.
Unit Head, Buildings & Services
Canadian Codes Centre
Institute for Research in Construction, National Research Council

Waterproof Door Sills

Achieving a durable, waterproof door sill is a difficult task. Even when a metal sill is used for durability and water resistance, the jamb remains the weak link. The jamb is typically fit tightly and caulked to the sill piece. However, the caulking is usually not maintained, so the joint becomes a path for water leakage. Over time, water works its way through and the cells of the wood jamb soak up the moisture. This is especially a problem where the door is in a location that is exposed to wind driven rain.

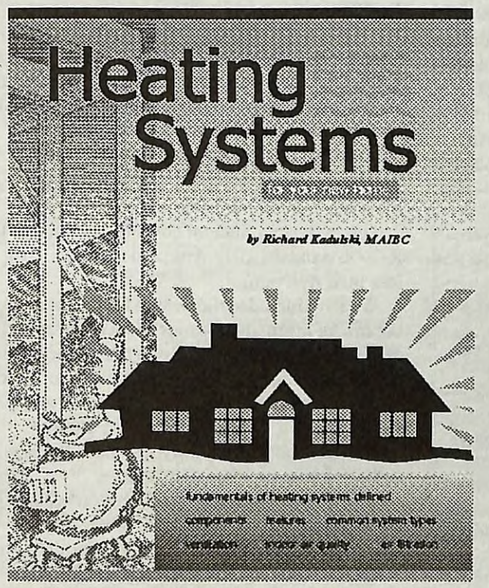
To deal with this problem, the folks at A K. Draft Seal Ltd., a Vancouver distributor and manufacturer of weather-stripping materials, have developed the ***SillTech 2000*** system which features a patented welded end-plate that eliminates water infiltration at the point where a traditional door jamb and doorsill meet. Properly used and installed, SillTech will be leak-resistant, rot-resistant, and maintenance-free.

The manufacturer is so confident of long term performance that they will warrant the SillTech 2000 system against defects in material, workmanship and water penetration for a period of five years when installed correctly. This longer warranty will be of interest to B.C. builders as by law they must now provide a 5-year water penetration guarantee.



One component of the system is also suited for use in window installations. It is marketed as Jamsill Guard. This is a one-piece pan sill flashing that helps to prevent water infiltration and moisture damage. These exterior door/window sill pans are injection moulded of high impact polymers that will not deteriorate over time. They have moulded ABS corners so they have no seams or caulked joints that can eventually fail. The profile allows for moisture drainage, and will accommodate most door and window units in 2x4 or 2x6 framing. All Jamsill Guards have bonding tabs and an extrusion that can be cut to length to allow for variations in rough opening size.

Information:
A K Draft Seal Ltd.
Tel: 604–520-1080
Fax: 604-520-3594
www.draftseal.com



$19.95 *Mail order: $ 23.49 ($19.95 + plus $ 2.00 shipping & handling + GST)*

Available Now!

Heating Systems
for your new home
by Richard Kadulski, MAIBC

Heating Systems for Your New Home is the book that explains heating system options for your new home.

Contents include:
- **Heating Fundamentals**
- **Heating System Types**
- **Features to consider**
- **Common system types described**
- **Overview of ventilation**
- **Filtration**
- And much more!

the drawing-room graphic services ltd.
Box 86627 North Vancouver, B.C. V7L 4L2
FAX (604) 689-1841
e-mail: solplan@direct.ca

Advanced Technology, Healthy and Energy Efficient New Homes

R-2000 energy efficient homes deliver much more than just lower energy bills. They are healthier, more comfortable, and quieter than standard houses, enhancing their liveability. Keep this mind, as we enter another period where energy efficiency and energy costs are entering public consciousness again.

Advanced Technology

R-2000 homes incorporate many of today's advanced technology for new homes. It is the intent of the R-2000 Technical Standard to encourage the use of leading edge technologies that are not only energy efficient but also that reduce the load on the environment by using materials with a lower embodied energy content, are more resource efficient and create a healthier indoor environment.

Healthy Homes

Health concerns are important to the public, and increasingly the awareness that the environment is a contributing factor to the health and well-being of residents is being made. No longer is the healthiness of home environments an anecdotal tale. Scientific studies by Health Canada comparing the health of residents in new R-2000 homes with those living in standard new construction are showing that there is a measurable improvement in the health of the residents of R-2000 homes.

For information on the R-2000 Program, contact your local program office, or call
1-800-387-2000

These findings support anecdotal evidence that R-2000 builders and home owners have been collecting over the years. The better indoor air quality in these homes is good for them. That is one reason that the American Lung Association took the R-2000 technical standard, customized it for their markets, and is now promoting the Health House program.

Energy Efficiency

Thanks to the insatiable energy appetite in the USA and California's distorted energy market, energy costs have risen drastically in the past year. The change in the energy picture, along with the growing concern about environmental degradation and climate change caused largely by fossil fuel use, energy consumption is becoming a big factor in the Canadian housing market again. Contrary to the predictions from the oil patch, it is inevitable that the higher energy costs we are seeing are going to continue with us. A further, more significant factor is that energy efficiency makes good environmental sense.

To show the impact of the changed situation, we did calculations for a typical new house, and summarized the findings in the table. The design we used is the house at the National Research Council's Institute for Research in Construction Canadian Centre for Housing Technology, and modelled it for five Canadian locations. The "code construction" assumption is the house built to current local construction practices. The R-2000 home is the same house using elements that would meet the R-2000 performance target.

Given the incremental cost of upgrading to the R-2000 standard, the payback in most cases will be less than five years.

We have included the Design Heat Loss number because of recent discussions about the over-sizing of heating systems. This is used to size the heating system, although unit size should take into account system efficiency, operating conditions and provide a margin for quick recovery. Builders will note it may be significantly less than the size of furnace found in many new houses.

The calculated energy consumption is based on standard user profiles and assumptions used in the HOT-2000 software. The estimates may not reflect actual energy requirements due to variations in weather, actual construction details used, performance of equipment, and occupant lifestyle.

	Construction standard	Design Heat Loss *(BTU/hr)*	Electrical energy cost	Natural Gas cost
Halifax	Standard code construction	51,486	$ 3,701	
	R-2000 home	36,700	$ 1,889	
Ottawa	Standard code construction	63,221	$ 2,322	$ 2,377
	R-2000 home	46,900	$1,293	$ 1,435
Toronto	Standard code construction	53,946	$ 2,215	$ 2,244
	R-2000 home	38,000	$1,154	$ 1,286
Calgary	Standard code construction	77,229	$ 4,893	$ 2,080
	R-2000 home	55,300	$ 2,541	$ 1,245
Vancouver	Standard code construction	44,595	$ 1,987	$ 1,543
	R-2000 home	30,200	$ 927	$ 859

The energy costs are for energy used for space heating and domestic hot water, at current posted prices, and do not include utility service charges or taxes.

Technical Research Committee News

Envirohome 2000

Following on his prior success, Steve Crowell of Crowell Construction of Kentville, NS, built the Envirohome 2000 to prove the relative simplicity of using available and affordable technology to improve occupant living standards. He focussed on health, accessibility and comfort, while also being respectful of environmental concerns. The idea was to use energy savings to pay for all improvements in health, accessibility, environmentally responsible construction and to recover the performance investment within five years.

Because the needs of homeowners change over time, Envirohome 2000 takes advantage of "Flex House Design" ideas. In most cases, visitors to the home will not be aware that it is barrier free. Yet a barrier-free design is better able to serve a larger segment of the population. Many barrier-free details do not have a big cost increase, if any. It is just a matter of anticipating the future at design or framing stages.

Examples of simple changes that improve access now or allow for easy future adaptation, and make a more useable home:

- bath and shower controls that are offset from the centre for easy access
- pressure and temperature control valves on faucets
- 2x blocking in all bathroom walls, to anticipate grab bars
- wider doors throughout the house - at least 2'10"
- light switches placed 42" above the floor
- electrical plugs 18" above the floor
- electrical outlets placed near the windows

Another design innovation is that the house has no interior bearing walls. Partitions can be easily moved, allowing future renovations to be done simply at a low cost.

By investing cost effectively in the building envelope, the initial cost for the Envirohome 2000 heating system is greatly reduced. Heating demands are met by a hydronic radiant heated floor slab that uses the same electric water tank which heats the domestic hot water. The floor slab has been designed to store thermal energy during periods when surplus solar energy is available or during off peak periods when electricity rates are lower (Nova Scotia has time-of-use billing). An Active Solar domestic hot water system preheats domestic hot water.

By combining geothermal heating, active solar heating, waste water heat recovery and photovoltaics, the home could potentially be self sustaining.

The energy efficient design is projected to use less than 4927 kWh of electricity per year for space heating. This is equivalent 4.13 KWh per sq. ft. per year (or 43.66 KWh per sq. metre).

This is just one example of innovation with the Envirohome program. For more information on how to participate contact CHBA.

Moisture and Wood-Frame Buildings

The Canadian Wood Council has begun publishing a series of Building Performance technical bulletins. The first bulletin covers controlling rainwater penetration in exterior walls and also provides ideas and solutions to improve the performance of wood-frame buildings.

The content includes a discussion of how moisture affects wood and also outlines moisture sources, moisture transport mechanisms and how exposure will affect amounts of moisture on the wall.

A section titled Moisture Design for Wood-Frame Buildings introduces the 4Ds of moisture management for exterior walls: deflection, drainage, drying and durability. Strategies for dealing with rainwater management are offered. A section on quality assurance during construction outlines techniques for ensuring that the building envelope is constructed as designed.

Fire Safety in Residential Buildings

The second bulletin in the Building Performance series covers fire safety issues in residential buildings and building codes. The content includes a definition of fire safety, strategies for preventing fire ignition, and how to manage the impact of fire by reducing the risk.

There is an overview of North American building codes with respect to fire safety in residential buildings.

A discussion on Fire Loss Statistics compares death and injuries from fires with respect to the building occupancy, how the fire started and the type of construction.

Canadian Home Builders' Association

The Technical Research Committee (TRC) is the industry's forum for the exchange of information on research and development in the housing sector.

Canadian Home Builders' Association,
Suite 500, 150 Laurier Ave. West, Ottawa, Ont. K1P 5J4
Tel: (613) 230-3060
Fax: (613) 232-8214
e-mail:
chba@chba.ca

Copies of the bulletins are available at no cost from:
Canadian Wood Council Help Desk - 1-800-463-5091 and on the Web at: www.cwc.ca

Water Problems at the Source

Water has been a high profile item in recent newscasts because of failures in various community water systems. The quality of our drinking water is now on everyone's mind. Many people rely on private water systems and private wells, especially in rural areas. These small private systems are prone to similar problems.

The media coverage should be a flag of caution for anyone with rural property. In Ontario alone there are about 500,000 mostly privately owned wells. The responsibility for maintenance lies with the owner of the well.

How Safe Is Well Water?

Water experts are appalled by what they have found seeping into the water sources rural home owners depend on. Thousands of private wells are contaminated. The water is unfit to drink. Many property owners pay little attention to water testing or well maintenance. Some don't even know where their wells are located.

Horror stories are legion among health and building officials and well maintenance contractors. Some discoveries include:

- A pail dropped down a plywood-covered well on a rope came up with 20 dead mice and three rats, and the home's tenants had been drinking the untreated water.
- In the top four feet of another well, 4,000 slugs had their home all producing excrement that was falling into water and causing E Coli readings.
- A woman believed that her well water was being treated with bacteria-zapping ultraviolet light. However, the bulb was burned out and was hooked into water pipes with rubber laundry hoses, a prime area for bacteria to grow.

Abandoned wells can contaminate neighbouring wells and underground water so must be plugged. To plug an old well, it must first be disinfected, then filled at the bottom with special grout or cement. Next, sand must be filled to near the surface before being topped up with compact clay. A drilled well needs to have its cap at least 10 inches above ground and a dug or a bored well should have 18 inches of clearance with the ground outside sloping away.

Checking for Water Problems

Newly drilled wells should be flushed for three to four weeks after construction and water tests should be taken before any hook-up in a home. Where water treatment is necessary, conditions always vary so the appropriate strategy must be selected based on testing of the water.

Information on how to disinfect a well with ordinary chlorinated bleach is published by the Canadian Institute of Public Health Inspectors. The leaflet is usually available from local health departments.

Drinking water treatment devices for bacteria include chlorinators, ultraviolet lights with filters, distillers and ozonators. Carbon filters and reverse osmosis do not kill bacteria, but they may improve bad tasting water and remove odours and some inorganic chemicals, such as nitrates. Ceramic filters use a silver-impregnated cartridge to disinfect water.

Disinfecting by Ultraviolet Light

A growing trend in disinfecting is the use of ultraviolet (UV) disinfection units, which rely on a UV light source. The unit is mounted so that water can pass through a flow chamber where UV rays are admitted and absorbed into the stream. These rays destroy bacteria and make many viruses inactivate.

UV, like distillation, disinfects water without chemicals, so possesses some of the same benefits as distillation: it does not create any new chemical complexes, does not change the odour of the water and does not remove beneficial minerals from the water. UV devices are most effective when the water has been pre-filtered so that only clean water passes through the UV flow chamber.

The germicidal effect of UV radiation depends on the intensity of the lamp and the length of exposure. The intensity of the light is enough to kill micro-organisms in a fraction of a second. The bulb as well as the quartz or plastic jacket should be removed and cleaned at least four times per year so the water will be exposed to full-strength UV rays. Hardness and iron or manganese, if present in the water, can prematurely coat the quartz sleeve, so more frequent cleaning may be needed.

The bulbs should be replaced at least annually (or as recommended), because most are rated for

Continued on page 13

Canada and the USA: Differences in the Energy Efficient Housing Scene

After eight years of work with the R-2000 Program, John Broniek decided to venture south. After two years in the US, he reflects on the differences, similarities, and challenges faced when trying to improve the energy efficiency of homes south of the border.

I am working for IBACOS, one of five firms involved in the Building America initiative, a federally sponsored initiative that has as its goal to get production builders (100 plus homes a year) to build more energy efficient and durable homes. My experiences have been with this type of "volume" builder in several regions.

Of little surprise, everything down here seems to be big – the builders, the developments and the houses. There are an increasing number of "volume" builders here, some who build more than 20,000 homes a year. More than 50 housing markets have at least 6,000 starts a year. Several developments we are involved in have more than 10,000 units. In addition, there is a wide variety of climatic conditions within the country. Enough variables to keep things interesting.

As in Canada, energy efficient housing is a tough sell – probably even tougher. The reasons for this are similar, but one additional factor, in my opinion, is that people here are blitzed commercially much more than in Canada. This media overkill makes consumers lean a lot more easily toward buying that "fancy bathroom faucet" than the high efficiency furnace. But, of course the situation is more complicated than that.

From a construction standpoint, several differences make energy efficient construction interesting. Mechanical contractors often put furnaces, air handlers and ductwork in unconditioned spaces like attics and garages. Large, two-storey homes over a full basement typically have a furnace in the basement to serve the first floor and a second unit in the attic to serve the second floor. In the south, two-storey homes on a slab-on-grade foundation will usually have two air handling units in the attic, one serving each floor. Mechanical contractors do this because the duct runs are less complicated, with a lot less cutting through joists and working

Continued from page 12

only about 9,000 hours.

However, there is no simple test to find out whether the system is providing proper disinfection. An effective cleaning program is necessary to ensure that biological and/or chemicals do not block UV transmission into the water. UV devices are more effective against bacteria than against viruses and parasites.

with chases. In addition, the builders' marketing staff appreciate having the extra floor space that duct chases might take up.

It might be a warmer climate in the south, but even in New York and New Jersey I have seen furnaces put in the attic. This is usually the first place where swords are drawn over energy efficiency.

Sometimes we find it necessary to have some of the ductwork go through the attic, because keeping it completely inside conditioned space is too onerous. This is especially the case in southern climates, where we advocate keeping supply registers in the ceiling or high wall locations because cooling is dominant in those areas. To keep supply air from being lost to the attic and return air being retrieved from the attic, duct air tightness is critical in these situations. Using flex duct reduces many of the joints typical in sheet metal ductwork, but connections to trunks and sheet metal boots require attention. Approved water-based duct mastic is recommended as the long-term cure to duct leakage. No matter where the home is located, we advocate an airtight, fully ducted air distribution system, coming from a centrally located furnace/air handler.

To avoid putting the furnace in the attic, our approach is to help builders design a home with only one furnace (in the basement or an interior mechanical room) and get them to upgrade the thermal performance of the building shell. Often, better windows and greater envelope air tightness are paid for by having one less furnace in the home and/or reducing the capacity of the condensing units, although zoning the ductwork and higher efficiency equipment must be factored in as well. Mechanical contractor resistance to this approach is high because they are on the hook when the homeowner calls saying that a second floor bedroom is too hot. Any change to the "normal" way of doing things is often looked upon as an unneeded complication, and is ripe with doubts about performance, especially since they have all the work they can handle.

The challenge to building air tightness is great. After observing blower door tests on new homes in the Atlanta area in the 10 ACH @ 50 Pa range, you know there is work to be done. Not all homes are that leaky, but in general, the warmer the climate, the leakier the home. In any case, standard home air tightness values do not approach the 3.0-4.0 ACH@ 50 Pa seen in the average new Canadian home. Since they do not use polyethylene as the air or vapor barrier here that may have something to do with this difference. Considering the moisture retention possibilities when poly is used in a milder climate, poly use in walls is decreasing and is totally absent in many regions. We discourage its use except in northern states like Minnesota. This is especially the case since kraft-faced batt insulation, widely available here, is such a popular and more forgiving alternative.

Consequently, one approach to air tightness in Building America homes is to use drywall as the air barrier. Draft-stopping exterior wall, floor and ceiling areas where there is no drywall is a major component of this tactic. In northern climates, we promote using insulated foam sheathing. Our air tightness goals are a lot more modest here than the equivalent R-2000 goal, with a 4.0 ACH@ 50 Pa blower door test result viewed as good.

Durability of Wall Systems Containing Housewrap

Innovation is important and to be encouraged. However, sometimes the effects of using new products are not completely understood, nor are the longer-term implications known. When new products are used, it is even more important to be careful about details used. Manufacturers' product performance claims have to be reviewed carefully and the intended functions of the products kept in mind.

Since its introduction nearly 20 years ago, the material generically called housewrap has undergone many developments. Many versions are available today and in some places the use of building paper has almost completely disappeared.

Housewrap is a thin, lightweight plastic fabric attached to the exterior sheathing behind the cladding. Most housewraps are made of polyolefin fibres that are spun, woven, laminated or fibre reinforced in a light-weight fabric.

Concerns have been raised about the widespread use of housewrap, and the debate about the relative merits of building paper and housewrap continues. Building paper is different from housewrap, and has different properties. The most important function of any membrane attached on the outer face of the exterior sheathing is to be a moisture barrier. As a moisture barrier, the sheathing membrane is meant to resist any wind driven rain or, any other water that may penetrate through exterior cladding and then, in turn, act as a drainage plane for this water. Both can successfully serve their main function. Which works better, in the end, depends on the quality of the installation.

A major reason housewrap is widely used is because it can be an effective air barrier to resist air movement across the construction assembly. Unfortunately, the way housewrap is usually installed, using staples in a screened, pressure-moderated, drained wall system, it is unlikely to contribute much to the overall air tightness of the wall system.

As a control layer for water vapour diffusion, it is intended to ease, but not retard, diffusion of water vapour. The intent is to allow the wall to dry rather than to have the housewrap layer retard water vapour flow. Water vapour diffusion in practice is not a concern because of the many staple or nail penetrations and the many other small holes and tears which serve to reduce the resistance to vapour flow by diffusion.

When properly installed, horizontal and vertical joints are overlapped - from two to 6 inches depending on the manufacturer's instructions - and taped or otherwise sealed to stop the infiltration/exhilaration of air and to prevent the inward movement of any water. The most important consideration is continuity. Window and door openings must have proper flashing details that incorporate taping and/or sealing to prevent the transfer of both air and water. Joints between overlapping layers should be taped or sealed. Any tears and holes should also be taped or sealed.

Housewrap Installation

The way housewrap is actually installed on the job site is another issue. The quality of attachment, and not the quantity of fasteners, is the concern. A study by the Pennsylvania Housing Research Centre found that in most houses the housewrap was only stapled. Where staples had been installed with a staple gun, tears and holes in the housewrap were common. Speed and rough handling of the staple gun seemed to cause many small tears and holes in the material.

Only 3% of builders surveyed used a plastic washer-nail combination. Where two separate sheets of housewrap overlapped, most of the overlaps were consistent with manufacturer guidelines, but most of the joints were not taped or sealed.

To prevent airflow and the ingress of water, the space between the window to wall joint has to be sealed. In most cases, builders neither sealed nor flashed the joints.

A properly installed housewrap should enable the wall - and it must be a screened and drained type of wall system - to function well. In a rain screen wall system, with a vented air space behind the cladding, the housewrap is the first air-barrier layer to actually experience wind-induced air pressure differentials.

Laboratory tests by the Pennsylvania Housing Research Centre examined the resistance to air movement of typical construction assemblies. Each wall section was tested for air leakage at pressures up to 1000 Pascals, under both positive and negative air pressures, to simulate windward and leeward wind pressures. The tests showed that the wall works as a system. Under positive or negative air pressure, the housewrap works in different ways.

It was found that housewrap by itself does reduce the movement of air, but it is significant only under positive pressures. Under negative pressures, because of the many punctures, the air leakage rates are essentially the same as the sheathing joint itself. Even at low pressure differences, some ballooning of the housewrap occurs under suction, so the air tightness of the housewrap, and the effectiveness of any pressure moderation, is reduced.

Looked at as a complete wall assembly, with kraft paper faced batt insulation and the interior gypsum sheathing (sealed only on the vertical edges) the air tightness of the wall system is increased significantly. However, a vented rain screen reduces the air tightness of each wall system. The nails used to attach the siding penetrate the housewrap and the exterior sheathing increased the air leakage.

Durability is not a property usually addressed in the housewrap literature except for general notes regarding ultraviolet exposure. The researchers expressed a concern about the cyclic and reversible nature of the wind action and the resulting air pressure differentials that the housewrap must accommodate.

Durability of Wall Systems Containing HouseWrap
E.J. Bosack and E.F. Burnett
Durability of Building Materials and Components
National Research Council Canada

OOPS!

Some days, your editor sleep walks through the day! In Solplan Review No. 97 (March 2001), we published an item to show a lighthearted view of how we so often market housing. (Marketing: What is the Message We are Really Sending?)

Much to my horror, I failed to note that there could be many Parsons in the country active in the construction industry. The correct one should get recognition. The credit for the piece was given to Jack Parsons, who is an R-2000 instructor. However, the real author is Rod Parsons, who also is an R-2000 instructor and builder very involved in energy efficient construction. Both Parsons live in St. John's, Newfoundland.

Rod is a long time builder, with experience in the UK as well as Ontario and Newfoundland. He has been active with CHBA, including having served a two-year stint as chair of the Technical Research Committee. He believes that getting the message out is important, and if it can be done with humour, so much the better.

energy efficient, sustainable, and healthy buildings
design & consulting services
R-2000 File Management
HOT-2000 Analysis
SuperE™ House Program Design Professional

Richard Kadulski Architect

#204 - 1037 West Broadway
Vancouver, B.C. V6H 1E3
Tel: (604) 689-1841
Fax: (604) 689-1841
e-mail: kadulski@direct.ca

Energy Answers

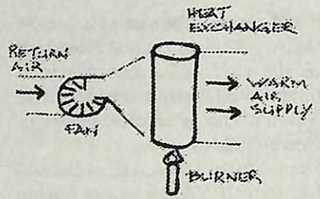
Rob Dumont

Natural gas prices have gone nuts last year. How can you improve the efficiency of an older, atmospheric vented natural gas furnace?

Before doing any furnace upgrading, I would strongly recommend that everybody with combustion equipment in their houses purchase a carbon monoxide detector. In Chicago and St. Louis, which have carbon monoxide detectors required by law, the death rates from carbon monoxide poisoning are about 40 times lower than in cities such as Los Angeles, Detroit and Atlanta that do not require detectors. [ASHRAE IAQ Applications, Vol 2, No. 2, 2001]

People soup up old car engines all the time - they are ported, polished, reamed, honed, stroked, heads shaved, new pistons, new valves, valve springs, new cams, new computer chips, etc., etc.

By comparison older furnaces have been almost totally neglected for efficiency upgrading. Fortunately, by comparison with car engines, furnaces are relatively simple.



The simplified sketch shows the basics of a simple furnace: burner, a forced air fan, and a heat exchanger.

To get higher efficiency from an existing furnace there are only two things you can do.

a. the heat transfer from the combustion gas.
b. reduce the excess air used for combustion.

The most practical way to improve the heat transfer across the furnace heat exchanger is to increase the amount of warm air flow to improve efficiency. Let me repeat in capital letters: INCREASE THE AMOUNT OF WARM AIR FLOW TO IMPROVE EFFICIENCY.

In cars, one way to increase efficiency and boost horsepower is to improve the air flow passages in the intake manifold by porting and polishing the flow paths. In addition, flow restrictions in the exhaust manifold, exhaust pipe and mufflers can be reduced by using larger diameter pipes, flow-through mufflers, and dual exhaust systems. The same principles can be used with warm air furnaces. Many older furnaces suffer low efficiency because of inadequate air flow on the warm air side of the heat exchanger. Reducing the flow restrictions in the supply and return air ducts is key to getting adequate warm air flow.

Quite often the return air side of the furnace ducting is under-sized. An inexpensive way to get more furnace air flow is first to make sure that the floor registers are open; in addition, there are newer types of floor registers that have lower flow restriction than the older pressed metal designs. Other means of boosting the warm air flow include cleaning the fan blades in the warm air fan, cleaning or replacing the furnace filter, and adjusting the pulley size on a belt driven fan to get a higher rpm. This latter technique of adjusting the pulley size should only be done with an amperage check on the motor to ensure that the rated amperage of the motor is not exceeded.

How can you tell if you are getting enough air flow through the furnace?

On most furnaces a specification label will include the necessary information. The information on a 1970 vintage Lennox G8 warm air furnace (110,000 Btu/h input; 88,000 Btu/h bonnet capacity) states: APPROVED AIR TEMPERATURE RISE: 70 - 105 °F.

For this furnace, the air temperature rise of the warm air flow should be between 70 °F and 105 °F (between 39 °C and 58 °C). Thus if the house air temperature is 72 °F, the warm air temperature leaving the furnace should be 72 °F plus 70 °F, or 142 °F [61 °C] at the low end, or 177 °F [81 °C] at the high end.

Using a simple thermometer, one can check to see that the temperature rise of the warm air as it passes through the furnace once the furnace has reached steady state is between 70 and 105 °F. For higher efficiency, the temperature rise of the warm air flow should be on the **low end** of that range. Why **low end**? Briefly, the reason you want a low temperature rise is that a low temperature rise means that the heat exchanger will be cooler (because of a healthy warm air flow) and a cooler heat exchanger will extract more heat from the combustion gases. Newer high efficiency condensing furnaces have temperature rise values that are even lower [about 40 to 70 °F (22 °C to 39 °C)]

What would happen if you increased the warm air flow on that older Lennox furnace so that the warm air temperature rise was lower than 70 °F?

The lower the temperature rise of the warm air flow, the more efficient the furnace, but also the more likely it will be that the combustion gases will start to condense in the venting system or the chimney. Older chimney systems are not able to handle the moisture from sustained condensation – and there is much condensing water available. A 100,000 Btu/hr furnace running continuously produces about a gallon of water vapour an hour. In short, by extracting too much heat from an older furnace you can destroy your chimney, and possibly kill the occupants in the house by venting combustion gases into the home.

A second way of improving furnace efficiency is to reduce the venting of house air up the chimney when the furnace is off. A vent damper can reduce the flow considerably. Unfortunately the cost of retrofitting a vent damper is substantial.

A third way of improving furnace efficiency is to eliminate the pilot light. A typical pilot light burns about 1,000 Btu/hour. Running continuously, it will use 8.8 million Btu a year, and most of that heat goes up the chimney. Using current natural gas prices here in Saskatchewan, which are scheduled to increase to about $9 per million Btu, that "little" pilot light will use $79 a year of gas. Unfortunately, the cost of retrofitting the pilot light is also substantial.

Tuning up an older furnace can improve the combustion efficiency by a measurable amount, perhaps as much as 10%. However, if you want savings in the range of 35%, my recommendation would be to change the older furnace for a new condensing furnace. With natural gas prices being doubled in the last while, there has never been a better time to make the upgrade.

New Guidelines for a Sustainable Municipal Infrastructure

We hear a lot about sustainable development. Much of this is a result of trying to come to terms with the havoc we have created on this planet. We simply have to clean up our act, and make sure that new developments and the repair and replacement of the existing infrastructure, do not repeat the mistakes of the past.

One area that could have a major impact is the urban infrastructure. Courageous designers and developers have occasionally suggested minor innovations, but these are hard to carry out due to bureaucratic and institutional inertia. Few authorities are willing to take a chance and approve something out of the ordinary - even if it may be cheaper, involve lower maintenance and, of course, be good for the environment. It's much easier to follow the recipes in the prescriptive cookbook.

A recent step to further the evolution and "greening" of the urban infrastructure is the announcement of the creation of the National Guide to Sustainable Municipal Infrastructure: Innovations and Best Practices, which will be developed by a consortium that includes a $27 million funding commitment from the Federal Government, the Federation of Canadian Municipalities, and the National Research Council.

The Guide will be a compendium of technical best practices for decision making, investment planning and for the construction, maintenance and repair of municipal infrastructure. The Guide should be an important step toward realizing the fundamental objective of using new "green" technologies and best practices to provide 21st century infrastructure to improve the quality of life of all Canadians. The National Guide will initially emphasize best practices and innovations in projects relating to drinking water, storm water and waste water systems. It will be available to municipalities of all sizes across the country, thus providing information about better and more innovative design and construction techniques.

It has been suggested that the adoption of best practices and innovations could lead to $800 million to $1.5 billion in savings on annual infrastructure maintenance costs for municipalities nation-wide. Long-term savings of this amount would represent a substantial return on investment for this initiative.

We hope that the fire-fighting community will join in and consider alternatives to excessively wide paved rights of way.

NRC·CNRC

Traffic Vibrations in Houses

by Osama Hunaidi and Jim Gallagher

Vibrations induced in buildings by road traffic are a common concern in cities in Canada and worldwide. Vehicle contact with irregularities in the road surface (e.g., potholes, cracks and uneven manhole covers) induces dynamic loads on the pavement. These loads generate stress waves, which move through the soil, eventually reaching the foundations of adjacent buildings and causing them to vibrate. Traffic vibrations are caused mainly by heavy vehicles such as buses and trucks. Passenger cars and light trucks rarely induce noticeable vibrations.

When a bus or a truck strikes an irregularity in the road surface, it generates an impact load and an oscillating load due to the subsequent "axle hop" of the vehicle. The impact generates ground vibrations that are predominant at the natural vibration frequencies of the soil since the axle hop generates vibrations at the hop frequency (a characteristic of the vehicle's suspension system). If the natural frequencies of the soil coincide with any of the natural frequencies of the building structure or its components, resonance occurs and vibrations will be amplified.

Factors Influencing Vibration Level and Frequency

The main frequencies and amplitude of the vibrations depend on many factors including the condition of the road; vehicle weight, speed and suspension system; soil type and stratification; season of the year; distance from the road; and the type of building. Generally, the rougher the road, the more speed affects the vibration amplitude. The effect of the suspension system type also depends on vehicle speed and road roughness. For low speed and smooth road conditions, the effect of the type of suspension system is not significant. But for high speeds and rough roads, the type of suspension system becomes important. An IRC study showed that vibration levels induced by a transit bus and a truck of the same weight category traveling on a rough road were similar at 25 km/h. At 50 km/h, however, vibration levels induced by the bus were at least twice those induced by the truck.

Also important are soil type and stratification. The lower the stiffness and damping of the soil, the higher the vibration. For impact loads, ground vibrations are highest at the natural frequencies of the site. At these frequencies, the soil and other similar structural systems offer the least resistance and hence the greatest response to loads. For soils, the natural frequencies depend on stiffness and stratification. Typically, traffic vibrations are worst in areas underlain by a soft clay soil layer that is between 7 and 15 m deep. In these areas, the natural frequencies of the soil can coincide with those of houses and their floors, leading to resonance or amplified vibration.

Where the topsoil normally freezes in winter, vibration levels in winter can be less than half those of other seasons. The number of complaints is usually highest during the spring thaw, when people notice the higher vibration levels after the relative quiet of winter.

Effects of Vibrations on People and Houses

Building vibrations caused by road traffic are not a health and safety concern; they are more an annoyance. Vibrations may be unacceptable to occupants because of annoying physical sensations produced in the human body, interference with activities such as sleep and conversation, rattling of window panes and loose objects, and fear of damage to the building and its contents. Experience has shown that people living in houses are likely to complain if vibration levels are only slightly above the perception threshold, the major concern being fear of damage to the building or its contents.

Vibration levels are rarely high enough to be the direct cause of damage such as cracks in walls and ceilings or foundation cracks, though they could contribute to the process of deterioration from other causes. Building components usually have residual strains as a result of uneven soil movement, moisture and temperature cycles, poor maintenance or past renovations and repairs. Therefore small vibration levels induced by road traffic could trigger damage by "topping up" residual strains.

The most stringent vibration guide value specified in published standards for damage to houses is more than 30 times the human perception level. In the IRC study mentioned above, vibration levels were found to be significantly lower than this value.

This article is adapted from Construction Technology Update No. 39, published by the Institute for Research in Construction. To order a copy of this Update, please access the following web site: http://www.nrc.ca/irc/catalogue/ctu.html

Dr. Osama Hunaidi is a senior research officer in the Urban Infrastructure Rehabilitation Program of the NRC's Institute for Research in Construction. Jim Gallagher is Manager of Publication Services at the Institute.

Suggested Solutions and Preventive Strategies

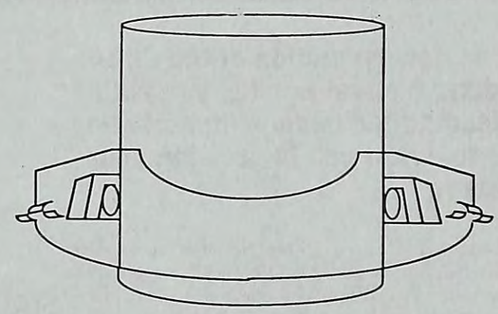
Maintenance of the road surface (for example, levelling manhole covers, patching potholes and applying a new pavement overlay) is the most economical and effective remedial method. However, it is usually a short-term measure; for example, cracks and defects in the original pavement reappear in the overlay. Reducing speed limits and restricting heavy vehicles, while effective, are usually difficult to enforce.

Improving the thickness and stiffness of the road is not effective for reducing vibration levels in the predominant frequency range of traffic-induced vibration. On the other hand, improvement of the soil structure under roads using deep mixing techniques could reduce vibration levels.

Increasing the distance between roads and houses might be a practical strategy for planned developments. Where vibrations result from impacts with a pothole or crack in the road, vibration levels could decrease by at least one-third for each doubling of the distance if the soil is homogeneous.

ENEREADY

ENEREADY PRODUCTS LTD. Tel. (604) 433-5697 Fax (604) 438-8906
#4 - 6420 Beresford Street, Burnaby, British Columbia CANADA V5E 1B6



Speedi™ Sleeve

4" Ventilation Grill Fitting

SOLPLAN REVIEW is an independent Canadian Journal published 6 times per year to serve the needs of professionals and interested lay persons. It provides news, technical details, new product information, insights and commentary on developments covering all aspects of building science and energy efficient building practice for new and retrofit residential construction. Technical information is presented in a clear, concise manner, without resorting to jargon.

SOLPLAN REVIEW is an independent subscription supported publication, that relies on the support of readers. *If you are seeing this journal for the first time, and find it valuable, why not ensure you don't miss any copies. Subscribe today!*

YES, I WANT TO SUBSCRIBE TO **SOLPLAN REVIEW**

In Canada: 1 year: $48.15 ($45.00 + 3.15 GST) [NB, NS, NF $51.75 includes HST]
2 years: 86.67 ($81.00 + 5.67 GST) [NB, NS, NF $93.15 includes HST]
USA and other foreign: 1 year $52.00 per year 2 years: 94.00 (USA and other foreign in US funds)
Pay by: VISA MASTERCARD CHEQUE

Card No. _____ Exp. date: _____

Signature _____

NAME _____

ADDRESS _____

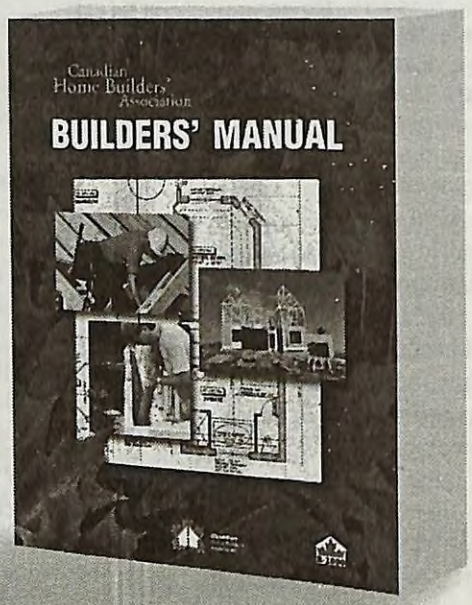
_____

POST CODE _____

the drawing-room graphics services ltd.
Box 86627 North Vancouver, B.C. V7L 4L2
FAX (604) 689-1841
e-mail: solplan@direct.ca

WHERE IS YOUR BUSINESS GOING?

Let the newest edition of the CHBA Builders' Manual provide you with the leading technical and marketing edge to assist you in growing your company



Canadian conditions make unusual demands on a builder. To withstand the world wide temperature fluctuations, rain, snow and sun of our country and the pressure to reduce CO_2 emissions, Canadian homes have to be built better.

The CHBA Builders' Manual is the leading book on quality construction and energy efficiency. Based on the tough Canadian climatic conditions, the building techniques pioneered in the R-2000 Program form the basis for this newest edition of the most authoritative guidelines anywhere in North America for building superior, energy efficient housing.

The newest and fifth edition offers 360 page of concise information and easy to follow illustrations. Use it as a guidebook or adapt the innovative techniques to your own methods.

Subjects Include:

- **Aspects of building science**
- **Design considerations**
- **Air, weather and moisture barriers and vapour diffusion retarders**
- **Materials**
- **Foundations**
- **Floors**
- **Walls**
- **Attics and roofs**
- **Windows and doors**
- **Domestic hot water systems**
- **Principles of space conditioning**
- **Distribution systems**
- **Heating systems**
- **Cooling systems**
- **Ventilation systems**
- **Other space conditioning equipment.**

Canadian Home Builders' Association

R-2000

Yes, I want to order the book!

Send me _____ CHBA Builders' Manual(s) at $65 each plus 7% GST ($4.55), mailing costs included. Business # 106347130RT

I enclose a cheque/money order in the amount of $ _____

Name _____

Company _____

Address _____

City _____ Province _____

Postal Code _____ Phone (____) _____

Please make cheque or money order payable to CHBA and mail to:

Builders' Manual Sales, Canadian Home Builders' Association

150 Laurier Avenue West, Suite 500, Ottawa, Ontario, Canada, K1P 5J4